The Influence of LAI Assimilation on Water Variables in a Land Surface Model

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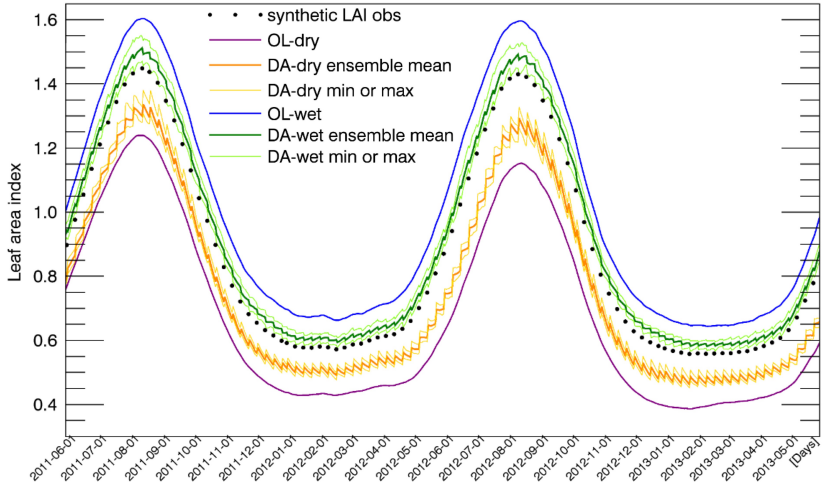
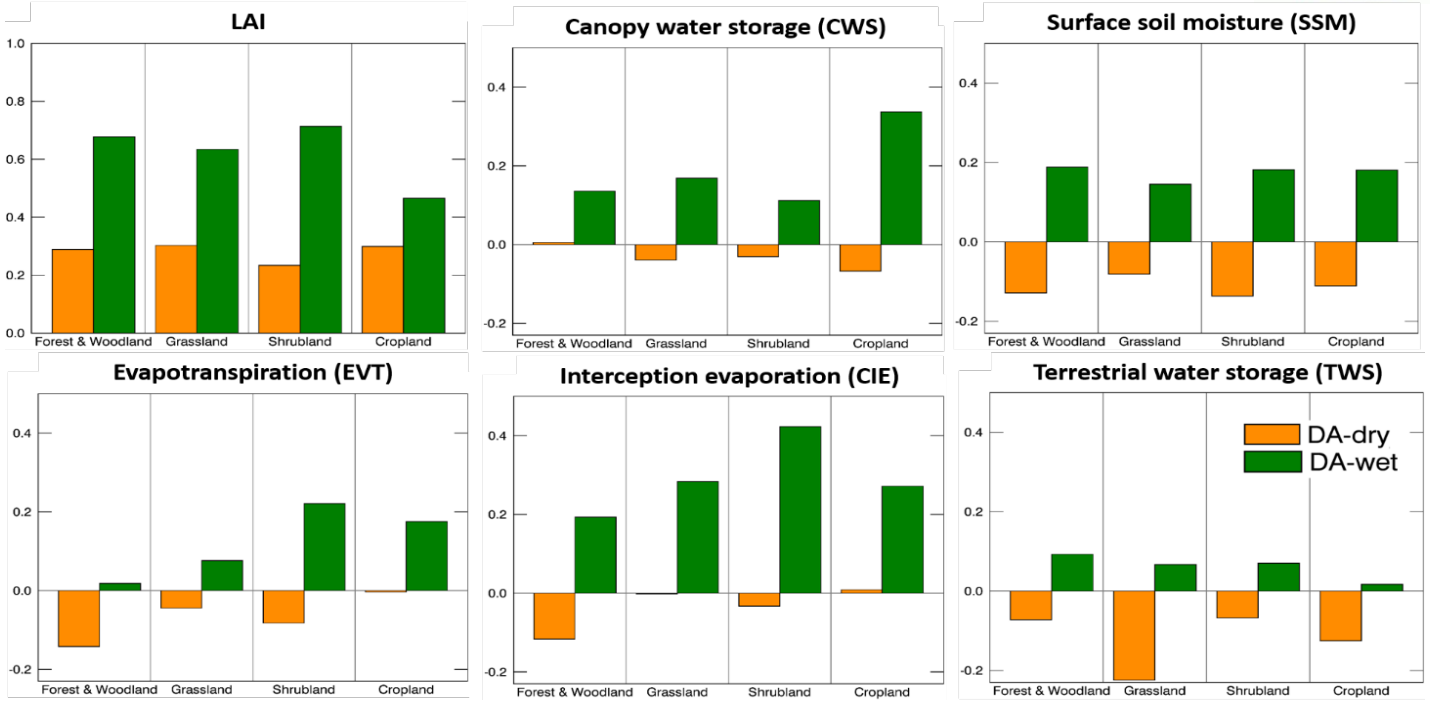
Global (Antarctica excluded) OSSE experiment:

- LSM: Noah-MP 3.6
- Meteorological forcing: MERRA2
- Simulations:
  - Nature run (NR): January 2011 to May 2013
  - Open-loop runs (OL):
    - dry condition: halving input precipitation
    - wet condition: doubling input precipitation
  - DA runs (DA):
    - EnKF with 20 ensemble members
    - Assimilation of 8-daily synthetic LAI observations sampled from the NR run under dry and wet conditions



Global averaged daily LAI

Zhang, X., V. Maggioni, A. Rahman, P. Houser, Y. Xue, T. Sauer, S. Kumar, and D. Mocko, 2020: The influence of assimilating leaf area index in a land surface model on global water fluxes and storages, *Hydrol. Earth Syst. Sci.*



Normalized Information Contribution (NIC) for different land cover types

$$NIC = \frac{RMSE_{DA} - RMSE_{OL}}{0 - RMSE_{OL}}$$

NIC = 1: DA realizes the maximum possible improvement over OL
NIC = 0: DA and OL have the same skills
NIC < 0 indicates a model degradation through DA

- For the selected water variables, LAI-DA improves model estimates in wet condition but worsen model estimates under dry condition for all land cover types.
- As the amount of water in Noah-MP is conservative, in the dry condition experiment, the model has no additional source of water in the system, even though the LAI assimilation is pushing the model towards more vegetation (that should result in more water).
- As a matter of fact, DA introduces more vegetation in the system, which results in more evaporation from the canopy and more water absorption from the soil. This whole process is most likely the cause for the poor performance of water-related variables in the dry DA experiment.